

Intermediate Photovoltaic System Design and Installation Workshop

About the Workshop

As photovoltaics (PV) continues to grow in popularity, an increasing number of contractors and specialists have incorporated PV into their business plans. If solar is part of your professional portfolio, this workshop will help you develop the specialized knowledge necessary to compete in this expanding market. This training provides an intensive overview of solar electric generation, system design and installation, current PV products, and compliance with the National Electrical Code (NEC).



Workshop Content

Day 1

- ❖ PV system design and installation overview
- ❖ Electrical design issues and problems
- ❖ Current PV products
- ❖ Final inspection and system acceptance

Day 2

National Electrical Code (NEC) compliance

- ❖ PV in NEC
- ❖ Key 2005 NEC Article 690 changes
- ❖ Permit Guidelines for Small-Scale PV Systems
- ❖ Inspection Guidelines for all PV Systems

[Please find our detailed agenda attached]

Bill Brooks, Trainer

Bill Brooks has been designing, installing, analyzing, and testing utility-interconnected PV systems since 1988. Over the past 7 years, Mr. Brooks' training has helped over 1,200 inspectors and over 2,500 electricians and installers understand the design and installation of code-compliant systems. His field troubleshooting techniques have been invaluable to attendees. Mr. Brooks holds Bachelor and Master of Science Degrees in Mechanical Engineering from North Carolina State University, is a Registered Professional Engineer in both North Carolina and California, and is the author of several technical manuals for the industry.

Who Should Attend?

Solar installers, electricians, building officials, inspectors, plan checkers, building contractors, and engineers.

Why You Should Attend?

To extend your understanding of design and installation techniques beyond the basic level.

When?

December 12 & 13, 2005 (Mon & Tue)
9 am – 5 pm. Registration opens at 8:30 am

Where?

University Business Center, Room 194
Craig School of Business, Cal State Fresno
5245 N. Backer Ave, Fresno, CA

Cost? \$50

RSVP by December 7. Space is limited!

Questions? Contact Nellie Tong
KEMA Inc, Technical Consultant for
CEC Renewable Energy Program
(510) 891-0446
nellie.tong@kema.com

Please fax your registration form to (510) 891 0440

or e-mail it to renewables@kema.com

For information on future workshops, please visit <http://websafe.kemainc.com/ProjectCenter/cec>

Registration Form

Course Title: Intermediate Photovoltaic Installation and Design Workshop

Date: December 12 and 13, 2005

This registration form can be downloaded at <http://websafe.kemainc.com/ProjectCenter/cec>

Please send a \$50 check payable to KEMA Inc to the following address:

PV Workshops

492 Ninth Street, Suite 220

Oakland, CA 94607

Name:

Company:

Phone number:

Email:

How have you been involved with PV? (eg. inspector, installer, educator, retailer, sales...)

Approximately how many years of PV experience do you have?


Approximately how many systems have you installed or inspected?

Approximately how many people/customers do you talk to per year about PV?

How did you hear about this workshop?

Please rate your level of understanding for the following topics, with 1 being very little to 5 being expert knowledge:

	Very little.....Expert Knowledge				
	1	2	3	4	5
PV System Design	1	2	3	4	5
System Installation	1	2	3	4	5
Performance calculations	1	2	3	4	5
Common problem with AC voltage	1	2	3	4	5
Common problem with DC voltage	1	2	3	4	5
Final inspection and system acceptance	1	2	3	4	5
Photovoltaics in NEC code	1	2	3	4	5
Key 2005 NEC Article 690 changes	1	2	3	4	5
Permit guidelines for small-scale PV systems	1	2	3	4	5
Inspection guidelines for all PV systems	1	2	3	4	5

To reserve a spot, please submit your registration form to renewables@kema.com or fax to (510) 891 0440  confirmation will be sent to you once payment is received.




Thank you for registering with us. Please contact Nellie Tong at 510 891 0446 or nellie.tong@us.kema.com if you have any questions.

Detailed Agenda

for the

Intermediate PV Workshop

Day 1:

1. PV System Design and Installation Overview:
 - 1.1.  ss Introductions
 - 1.2. PV characteristics—Understanding IV curves
 - 1.2.1. How curve changes with irradiance, temperature, and age
 - 1.3.  performance calculations with and without computer
2.  Electrical Design Issues and Problems:
 - 2.1. Effects of series versus parallel combining of PV modules
 - 2.2. Shading—vents, inter-row, buildings and trees
 - 2.3. DC voltage concerns
 - 2.4. AC voltage concerns
3. Current PV Products:
 - 3.1. Building-applied and building-integrated products
 - 3.2. Review of currently available standard modules and inverters
 - 3.2.1. How to choose products by warranty, technology, company size, years in business, price, etc...
4. Final Inspection and System Acceptance:

Day 2:

5. National Electrical Code (NEC) Compliance
 - 5.1. PV in the NEC
 - 5.2. Key 2005 NEC Article 690 code changes that impact 2002 NEC interpretation
 - 5.2.1. Article 690.13 and 690.14 Disconnecting Means—clarification on location
 - 5.2.2. Article 690.35 Ungrounded Photovoltaic Power Systems (690.41 Exception for consistency)
 - 5.2.3. Article 690.64 options for connecting to an electrical service
 - 5.2.3.1. (B) (5) no clamping for 690.60 inverters
 - 5.3. Permit and Inspector Guidelines
 - 5.3.1. Permit Guidelines for Small-Scale PV Systems
 - 5.3.1.1. Basic site diagram identifying location of major components—not to scale.

- 5.3.1.2. One-line electric diagram showing all major field-installed electrical components, wire identification and sizing, and grounding.
- 5.3.1.3. Major component information (inverter, module, batteries)
- 5.3.1.4. Array information
 - 5.3.1.4.1. Array configuration
 - 5.3.1.4.2. Electrical parameters
- 5.3.1.5. Wiring and Overcurrent Protection
 - 5.3.1.5.1. Wire Type and Conductor Ampacity
- 5.3.1.6. Provisions for the PV power source disconnecting means:
- 5.3.1.7. Grounding (equipment and system grounding)
- 5.3.1.8. Array Mounting information
- 5.3.1.9. Costs of Permits
- 5.3.2. Inspection Guidelines for all PV systems
 - 5.3.2.1. Equipment, conduit, and wiring installed according to approved plans.
 - 5.3.2.1.1. PV module model number matches plans and cut sheets.
 - 5.3.2.1.2. PV modules are properly grounded
 - 5.3.2.1.3. Check that wiring is consistent with callouts on plans (number of modules)
 - 5.3.2.1.4. Check that cable and conduit is properly supported
 - 5.3.2.1.5. Where plug connectors are used for module wiring, inspect a sample of the connections to make sure that connectors are fully engaged
 - 5.3.2.2. Structure attached according to plans and directions.
 - 5.3.2.3. Appropriate signs installed.
 - 5.3.2.3.1. Sign construction
 - 5.3.2.3.2. Provide a sign identifying DC power system attributes at DC disconnect
 - 5.3.2.3.3. Provide a sign identifying AC point of connection
 - 5.3.2.3.4. Check that label on inverter matches callouts on one-line diagram.
 - 5.3.2.3.5. Provide a sign identifying switch for alternative power system.
 - 5.3.2.3.6. If system includes an Optional Standby System, provide a sign at the main service disconnect [702.8] notifying the type and location of the optional standby system.